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REVIEW ARTICLE

Strategies of a Brazilian National Program for maintaining the compliance of animal products with a view to serving the global market

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Abstract

Effective food control systems are important to ensure the safety of food produced and to protect consumers, as well as to boost food exports. This review aims to provide an overview of the strategies applied by Brazil's Federal Inspection Service (SIF) regarding the quality of products of animal origin, including the Program for Evaluation of Physicochemical and Microbiological Compliance in Products of Animal Origin (PACPOA). In this program, it was carrying out the collection and analysis of animal product samples across more than 3,000 industries/slaughterhouses registered in SIF. The results in 2024 indicate that 24,786 physicochemical and microbiological analyses were carried out on 6,478 samples. The percentage of compliant samples observed was 84.21% (5,455/6,478), with 87.85% (2,863/3,259) for microbiological parameters and 80.52% (2,592/3,219) for physicochemical parameters. The PACPOA is aligned with international guidelines, with the monitoring of products of animal origin in industries/slaughterhouses, using official laboratories and internationally validated and/or recognized analytical methods, providing transparency on the safety, identity, and quality of products, and is aligned with product monitoring strategies and results in other countries.

Keywords

Animal products, compliance, Federal Inspection Service, food control systems, food safety, monitoring program

Introduction

Food quality and safety are important determinants of health and disease in the population. National food control systems aim to ensure that the food produced is safe, healthy, and fit for human consumption and complies with food safety and quality requirements, protecting consumer health (FAO 2020). For this, surveillance and monitoring in public health systems are necessary. Surveillance is usually applied in planning the strategy for

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controlling diseases or illnesses. In contrast, monitoring is applied in developing programs and is linked to control actions. The main similarity is that both surveillance and monitoring are ongoing activities that must consist of three components: data collection, regular analysis of the data, and broad and periodic dissemination of the data to all those who need it (Waldman 1998). Among the many applications of monitoring, the continuous analysis of quality indicators of products for human consumption are included (Waldman 1998).

According to estimates by the World Health Organization (WHO 2015), around 600 million cases of foodborne illness (FBD) occur worldwide each year, and approximately one in 10 people in the world is affected by these, with 40% of these illnesses occurring in children under 5 years of age, and approximately 420,000 people dying every year. Estimates from the United States indicate that around 48 million new cases of food-related illness occur every year, resulting in 3,000 deaths and 128,000 hospitalizations (Scharff 2012). In China, between 2011 and 2014, 4,207 outbreaks of foodborne illnesses were recorded (Zhou et al. 2018). Data from the Ministry of Health in Brazil showed that among the 2,112 outbreaks of FBD reported to the Epidemiological Surveillance System between 2014 and 2023, animal products were incriminated in 22.7% of the outbreaks (Ministério da Saúde 2024).

Adoption of effective food control systems is important to ensure the safety of food produced in the country and to protect domestic consumers, as well as to guarantee the safety and quality of exported and imported food (Jia and Jukes 2013). Therefore, the effectiveness of food control systems is part of the proper mechanisms for food safety governance since they make up a set of strategic leadership and control actions that, in practice, aim to evaluate, direct, monitor, and follow up on food safety (Kraak and Niewolny 2024). Strengthening a country's veterinary services to prevent and protect animal health and food safety is a driving force behind the population's nutritional security and fair and safe trade between countries.

The need for knowledge and effective action on relevant problems in the fields of public health, animal health, environmental health, or the combination of these, which reflect a one health approach, has promoted the adoption of strategies to improve the efficiency and effectiveness of food surveillance and control systems or programs in different countries, also promoting the development of an evaluation culture recommended by international guidelines (Whitehead 1995; Mota et al. 2012; Calba et al. 2015; Mota et al. 2020).

Regular evaluations of food surveillance and control systems or monitoring programs, identifying the strengths and weaknesses of the systems, can provide comprehensive improvements in public policies, seeking to prioritize the monitoring of animal products that present the greatest risk to consumer health (Whitehead 1995; Mota et al. 2012; Peyre et al. 2019).

Depending on epidemiological, sociological, and economic factors, disease surveillance systems can be complex, including various attributes that can be used to evaluate their performance. There is a need to use multiple methods or tools in the evaluation process. Like surveillance systems, food control programs can vary in methods, scope, and objectives. This means that evaluation approaches must be flexible enough to consider these variations (Calba et al. 2015).

In Brazil, Law 8.171 of January 17, 1991 (Brasil 1991), which is the basis of agricultural policy in the country, has, as one of its objectives, to ensure the quality of agricultural products by inspecting products of animal origin. Decree 5.741 of March 30, 2006 (Brasil 2006), which organizes the Unified Animal and Plant Health System (SUASA) in Brazil, requires compliance with microbiological criteria and quality standards for products of animal origin; the prevention, elimination, or reduction of risks to acceptable levels; and the observance of official sampling and analysis methods.

The hygienic-sanitary, technological, and industrial inspection of products of animal origin is the responsibility of the Government, represented by the Federal Inspection Service (SIF), the State Inspection Services (SIE), and the Municipal Inspection Services (SIM). National and international marketing of products of animal origin is carried out by industries inspected by the SIF, intra-state marketing by those inspected by the SIE, and intra-municipal marketing by those inspected by the SIM. However, Decree No. 5,741 of March 30, 2006 (Brasil 2006) also instituted the Brazilian System for the Inspection of Products of Animal Origin (SISBI-POA), whose integration into the system by the SIE and SIM, by equivalence to the SIF legislation, allows for the national marketing of products of animal origin.

In the case of the Federal Inspection Service, Law No. 1,283 of December 18, 1950 (Brasil 1950) provides for the Ministry of Agriculture and Livestock (MAPA's) competence in the sanitary and industrial inspection of products and by-products of animal origin in industries/slaughterhouses engaged in international or interstate trade (Fig. 1). Therefore, improving the conformity of products of animal origin is reflected in safety and quality, and this is an objective pursued by the SIF.

Regardless of the type of inspection, the work of official inspection services is essential for obtaining safe animal products. It is a "one health" strategy carried out by official veterinarians who work technically to ensure compliance with legislation, with an emphasis on monitoring microbiological or physicochemical hazards, traceability, risk analysis, combating fraud, and, in the case of the Federal Inspection Service, compliance with international market requirements (Passador Filho et al. 2025; Xavier and Limberger 2025).

This article aims to provide an overview of the strategies applied by Brazil's Federal Inspection Service regarding the quality of products of animal origin, considering the challenges of the Program for Evaluation of Physicochemical and Microbiological Compliance in Products of Animal Origin (PACPOA) and the demands for quality from the global market.

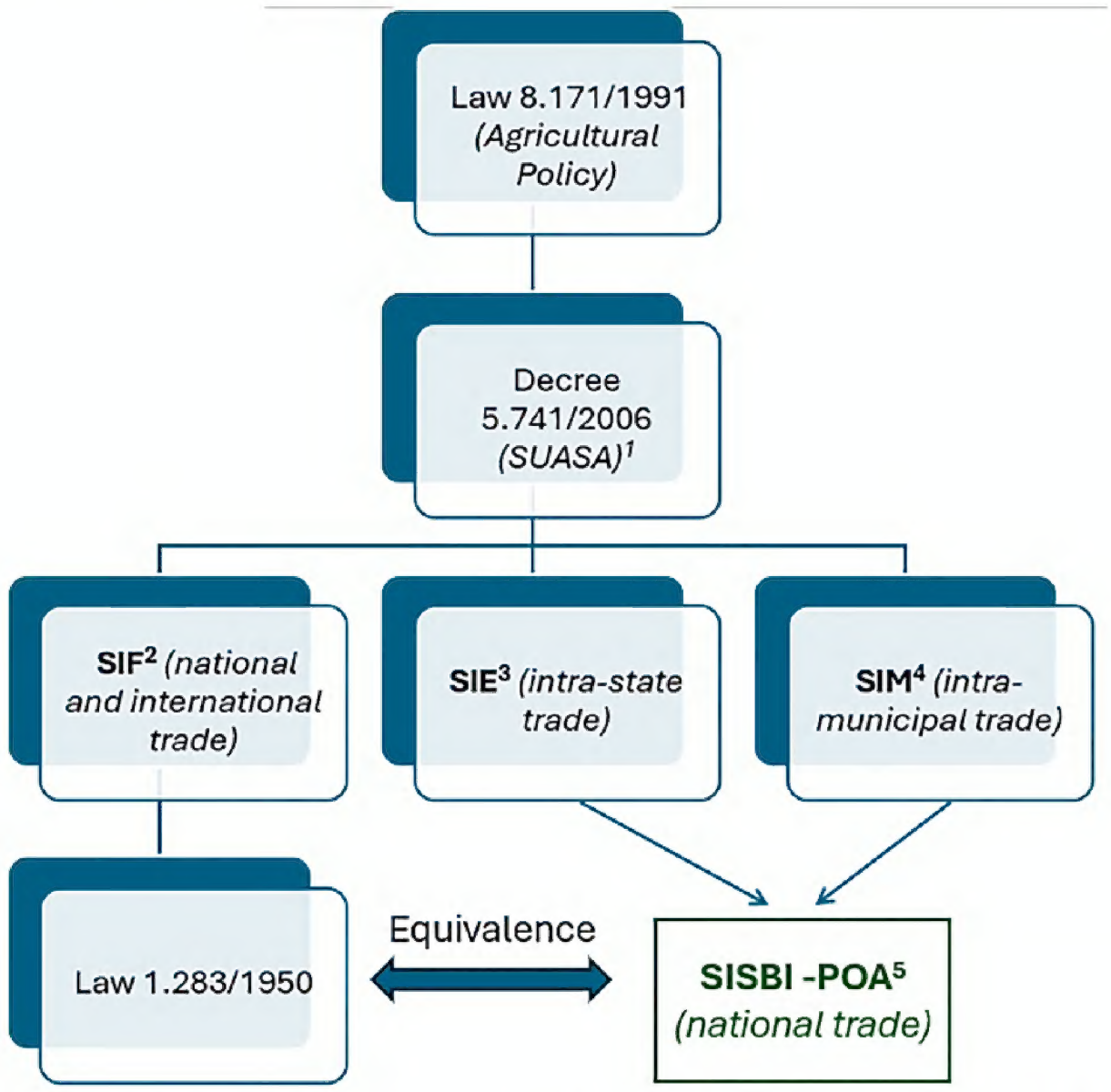

Figure 1. Basic legislation and scope for trade animal products in Brazil. [1] Unified Agricultural Health Care System (SUASA); [2] Federal Inspection Service (SIF); [3] State Inspection Service (SIE); [4] Municipal Inspection Service (SIM); [5] Brazilian Animal Products Inspection System (SISBI-POA). Source: The authors.

Considerations about food control systems and the Federal Inspection Service (SIF)

Food Fraud is a risk related to food arising from an intentional action, with the motivation of economic gain, but without the intention of causing direct harm to the consumer's health. Food Quality is a risk related to unintentional action, without direct harm to health. Food Safety is a risk arising from an unintentional action, with potential harm to the health of consumers. Food Defense is a risk associated with an intentional action, with the intention of causing harm to health. These concepts were adapted from Spink et al. (2019) and illustrated in Fig. 2.

According to Unnevehr (2022), in traditional inspection systems, food safety is aligned with food (supply) and nutrition security. As in Brazil, in the inspection systems of economies in transition, food safety is aligned with the development of markets and agriculture, including concerns about microbiological risks and food adulteration. There is concern about the development of food safety monitoring programs for important public health risks and investment in improving laboratory capacities.

One of the components of official food control systems is the establishment of specific and appropriate legislation to control product safety, with the adoption of requirements or standards (national or international) for processes and finished products, among other quality requirements that must be applied at all stages of the production process, right through to the end consumer (Whitehead 1995).

National or international standards can be expressed as Food Safety Objectives (FSO), which refer to the maximum level of microbial contaminants acceptable at the point of consumption, aiming for a level of protection considered appropriate for the consumer, and which can be directly applicable to the previous stages of the food production chain, such as primary production, industrialization, and marketing (Doménech and Martorell 2016; Wahidin and Purnhagen 2018).

These rules or standards are important not only for public health, but also for international trade. Strengthening federal legislation on products of animal origin, with official rules for production, definitions of product identity and quality standards, hygiene parameters and product characterization, and seeking harmonization with international regulations governing food trade, including the control of risks related to chemical, physical and biological contaminants are important mechanisms adopted by Brazil to guarantee food safety and strengthen international trade (Brasil 2017; Figueiredo et al. 2017).

The SIF operates on a permanent basis in slaughterhouses used for slaughter, and periodically with a frequency of fortnightly, bimonthly, biannual, or annual inspections, in other industries used for processing meat and meat products, milk and milk products, honey and bee products, eggs and egg products, and fish and fish products, according to the risk characterization of industries/slaughterhouses and products (MAPA 2017).

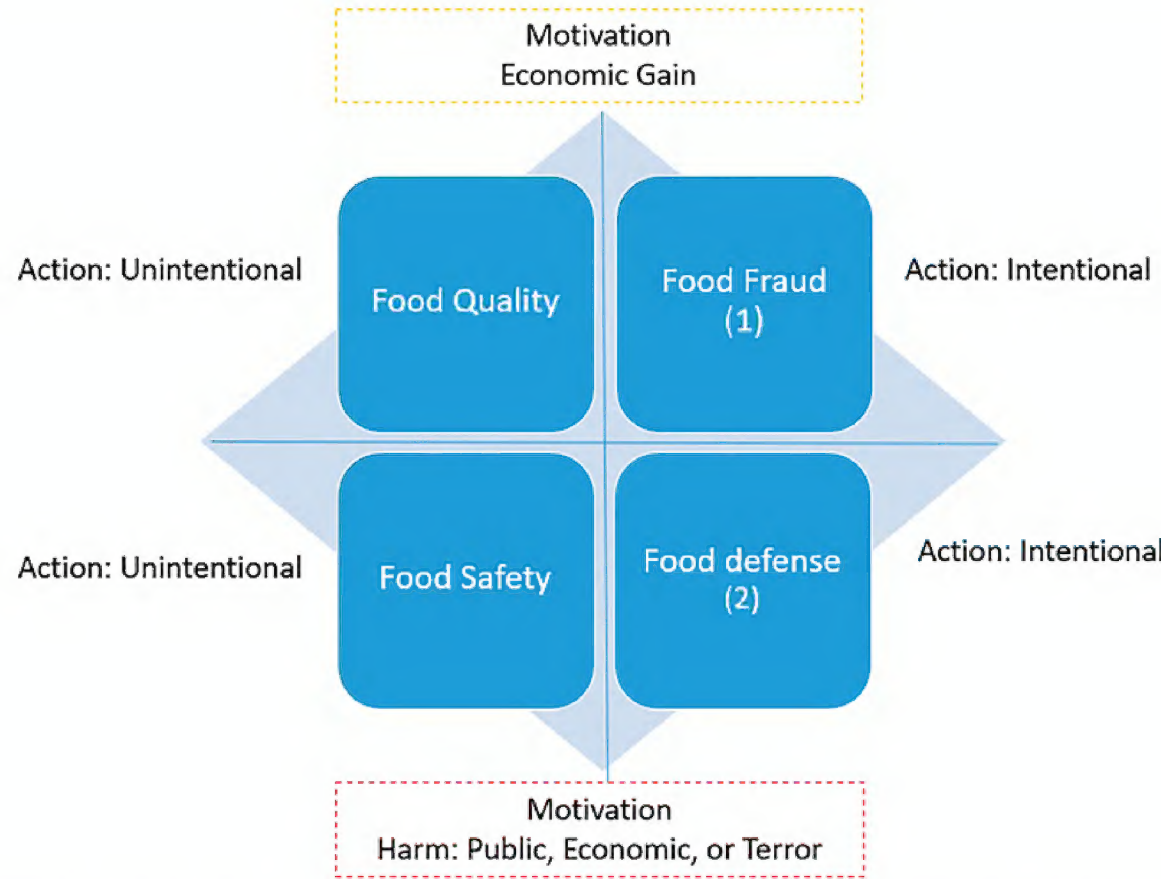

Figure 2. Food risk diagram defining food quality, food safety, food defense and food fraud. Source: Adapted from Spink et al. (2019). (1) Includes the US/FDA defined a subcategory of economically motivated adulteration as well as food counterfeiting. (2) Includes the US/FDA defined food defense scope of "wide-scale human health harm" as well as the general scope of all intentional acts intended to cause harm.

According to MAPA (2024a), in April 2024, the SIF was responsible for inspecting 3,013 registered industries/slaughterhouses, covering 1,443 municipalities, of which 330 municipalities have registered slaughterhouses under permanent inspection, as well as exporting Brazilian animal products to more than 180 countries (MAPA 2024b).

The establishment of official monitoring programs is one of the tools used by food control systems to achieve their objectives. These programs are defined as a set of actions, and their performance must be measurable by indicators that are consistent with the established objective. Therefore, one of the objectives of official verification programs is to confirm that industries/slaughterhouses' self-control systems are operating properly and that microbiological or physicochemical hazards are efficiently kept under control by the producing establishment (Milios et al. 2014).

Monitoring and actions related to the detection of microbiological fraud and incidents with global repercussions

The fight against fraud and adulteration of products of animal origin reinforces the importance of solid national legislation and a clear definition of the functions and duties of health authorities in the inspection and control of products through the development of food safety standards and the strengthening of laboratory control (Figueiredo et al. 2017).

Risk assessment strategies and the strengthening of legislation to prevent and combat food fraud are recognized by countries and international bodies as important tools for the development and reliability of countries' food inspection systems (Spink et al. 2019). Therefore, the legal framework of Brazil's SIF already includes in its definitions the concern with aspects of food quality, food safety and food fraud.

It can be seen that in Brazil, the sanitary and industrial inspection of products of animal origin has been mandatory since 1950, under Law No. 1,283 of December 18, 1950 (Brasil 1950), and is a public activity carried out by the Federal Inspection Service (SIF) of the Department of Inspection of Animal Products (DIPOA), which is the agency of the Ministry of Agriculture and Livestock (MAPA) responsible for the inspection and supervision of industries/slaughterhouses that carry out interstate and international trade in products of animal origin (Brasil 2017; Magioli 2017).

As a tool for prioritizing risk-based inspections and audits, SIF assesses the performance of the industries/slaughterhouses producing products of animal origin in terms of compliance with the applicable legislation, including monitoring the occurrence of violations of identity and quality standards, microbiological standards, physicochemical standards or residue and contaminant limits in products, detected in official analyses or international notifications (MAPA 2022a).

The Regulations for the Sanitary and Industrial Inspection of Products of Animal Origin, established by Decree 9.013 of March 29, 2017 (Brasil 2017), are among the most important regulations related to the inspection of products of animal origin, which has internalized international standards from the Codex Alimentarius, such as the general principles of food hygiene (Vasconcelos 2024). This regulation defined what are considered altered products, which do not present adequate hygienic-sanitary conditions and pose a risk to public health, and adulterated products, which are fraudulent or counterfeit.

In Brazil, there have also been situations with major national or international repercussions related to safety problems or adulteration of animal products, such as in 2007, the adulteration of raw milk with whey, caustic soda, sodium citrate and hydrogen peroxide was combated in a police operation (Operation "Ouro Branco") carried out in the state of Minas Gerais (National Institute of Criminalistics 2022); there were also scandals involving the adulteration of raw milk with water and agricultural urea containing formaldehyde, in the state of Rio Grande do Sul, between 2013 and 2015, known as Operation "Leite Compensado" (Roncato et al. 2017); the beef adulteration scandal in Brazil in 2017, which led to the launch of a police operation (Operation "Carne Fraca") involving around 30 companies producing meat and meat products (Magioli 2017; Unnevehr 2022); also in 2017, Operation "Tripoli" was launched in the state of Santa Catarina, identifying fraud and adulteration in fish, through the addition of substances (polyphosphates) to increase water absorption in fish fillets, uncompensated freezing (ice excess) in fish packaging and the substitution of fish species (MAPA 2017).

Cases of fraud in food of animal origin have been observed in various parts of the world, and have been linked to joint action with police forces and justice. In 2006 in India (Jena 2018; Shukla et al. 2018), and in 2009 in China (Jia and Jukes 2013; Zhou et al. 2018) and, following scandals related to the safety of food of animal origin (e.g. adulteration of powdered milk with melamine; contamination of Jinhua ham, eggs with Sudan dyes; counterfeit lamb or beef; pesticides in bottled water and soft drinks; and chili peppers with Sudan dye), these countries needed to adapt legislation related to food safety to strengthen their inspection systems and assign responsibilities to ensure food safety.

The importance of maintaining an internationally certified support laboratory network with reliable analyses

The inspection system encompasses the complete evaluation of the food production chain to ensure compliance with the minimum requirements demanded. It must have sufficient analytical capacity and the ability to determine or monitor the level of food quality. Therefore, official control laboratories are an important component, as they help to identify and quantify contaminants and hazards for proper decision-making by the competent authorities. It is important to have an effective, quality and reliable laboratory network to support surveillance activities, monitoring programs and official verification. Food samples are analyzed for chemical or microbiological contamination, and sometimes nutritional parameters by health authorities. Validated methods should always be used to guarantee the reliability of the results (Whitehead 1995; Freitas et al. 2006; Luber et al. 2011; Jia and Jukes 2013; Shukla et al. 2018).

To carry out the official analyses, Brazil has six official laboratories, called Federal Agricultural Defense Laboratories (LFDA), located in the states of Goiás, Minas Gerais, Pará, Pernambuco, Rio Grande do Sul and São Paulo and the Advanced Laboratory Section of Santa Catarina (SLAV-SC) (Fig. 3). The laboratories are accredited by ISO 17025/INMETRO, carrying out internal audits, national and international proficiency tests, calibrated equipment, reference strains, evaluated inputs and traceability, and

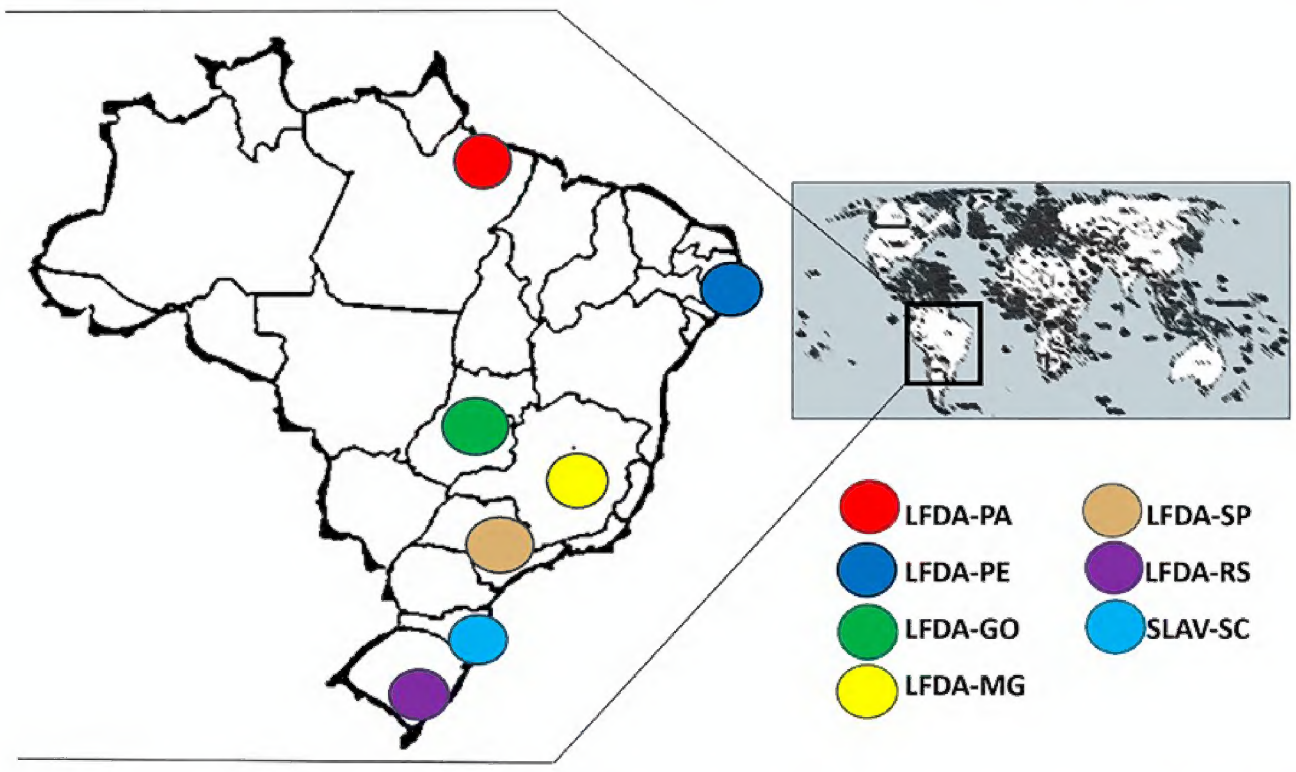

Figure 3. Map showing the location of the six Federal Agricultural Defense Laboratories (LFDA) and the Advanced Laboratory Section of Santa Catarina (SLAV-SC) in Brazil. LFDA PA = Federal Agricultural Defense Laboratory (Belém, State of Pará); LFDA PE = Federal Agricultural Defense Laboratory (Recife, State of Pernambuco); LFDA MG = Federal Agricultural Defense Laboratory (Pedro Leopoldo, State of Minas Gerais); LFDA GO = Federal Agricultural Defense Laboratory (Goiânia, State of Goiás); LFDA SP = Federal Agricultural Defense Laboratory (Campinas, State of São Paulo); LFDA RS = Federal Agricultural Defense Laboratory (Porto Alegre, State of Rio Grande do Sul) and; SLAV-SC = Advanced Laboratory Section of Santa Catarina (São José, State of Santa Catarina). Figure source: Adapted from MAPA (2022b). World Map presented is public domain according to the UN Geospatial Information Section. Available for free use at https://www.un.org/geospatial/content/map-world-1.

recognized internationally, and meet the demand for analyses of official compliance programs, pathogen control, and monitoring of residues and contaminants in animal products carried out by the Federal Inspection Service (MAPA 2022b; Brasil 2024b).

Microbiological monitoring procedures and criteria

In Brazil, microbiological criteria, food safety objectives, and verification of the identity and quality of animal products are adopted as self-control and official control strategies in animal product industries/slaughterhouses related to Compliance Programs and National Pathogen Control Programs (Table 1). The Brazilian Official Programs were developed through a partnership among the Federal Inspection Service, official laboratories, and universities or research centers, providing the scientific basis for sample planning and execution (Brasil 2013). Samples are collected exclusively by trained staff working for the SIF, and analyses are carried out in official laboratories MAPA (2024a).

Annual sampling plans are drawn up for official programs, where samples of animal products or raw materials are collected from producing industries/slaughterhouses, based on the size classification of industries/slaughterhouses and product categories, according to the number of animals slaughtered daily or the monthly production volume; the expected prevalence of pathogenic microorganisms, such as Salmonella spp., E. coli STEC, or Listeria monocytogenes; the history or risks associated with specific products or groups of products; or the expected frequency of deviations in product safety, identity or quality parameters (MAPA 2024a).

One of the official programs carried out in Brazil is the monitoring and control of Salmonella spp. in poultry carcasses in slaughterhouses registered under SIF, which has been carried out in the country since 2003, and was updated in 2016 through Normative Instruction No. 20, of October 21, 2016 (Brasil 2016; Brasileiro 2020). Hygienic and sanitary control in the poultry slaughter process was also instituted in 2024, through the monitoring of the indicator microorganism Enterobacteriaceae (Brasil 2024a).

Listeria monocytogenes, another food-borne pathogen of great importance in public health due to its high mortality, albeit with a low incidence, has been monitored in Brazil since 2009 in ready-to-eat animal products (Brasil 2009; Rodrigues et al. 2017). In 2018, official monitoring and control of Enterobacteriaceae and Salmonella spp. in pig and cattle slaughterhouses was also instituted in Brazil, as well as research into E. coli STEC (serogroups O157, O26, O45, O103, O111, O121 and O145) in beef (Brasil 2018a), based on national prevalence studies conducted by the SIF (Brasileiro 2020).

In Brazil, the strategy adopted to monitor and manage the risk of chemical hazards in industries/slaughterhouses registered with the SIF is the National Program for the Control of Residues and Contaminants in Animal Products (PNCRC), which monitors pharmaceutical inputs used as components of veterinary medicines, pesticides and contaminants, such as heavy metals, mycotoxins and dioxins, whose legislation was updated based on Ordinance SDA/MAPA No. 1,266, of April 16, 2025 (MAPA 2024a; Brasil 2025).

Table 1. Summary of official control and monitoring programs for animal products and processes carried out by the Federal Inspection Service in Brazil.

Program	Monitoring	Species/Products	Reference
1. Ordinance SDA/MAPA No. 1,266, of April 16, 2025	Residues of veterinary drugs, pesticides and contaminants such as heavy metals, mycotoxins and dioxins in products of animal origin	Raw materials and products in meat, honey, milk, fish and eggs	Brasil (2025); MAPA (2024a)
2. Normative Instruction No. 9, of April 8, 2009	*Listeria monocytogenes*	Ready-to-eat products of animal origin	Brasil (2009); Rodrigues et al. (2017)
3. Internal Standard No. 4, of December 16, 2013	Physico-chemical and microbiological compliance of animal products	Edible products of animal origin	MAPA (2013); MAPA (2024a)
4. Normative Instruction No. 20, of October 21, 2016	*Salmonella* spp.	Poultry carcasses	Brasil (2016); Brasileiro (2020)
5. Normative Instruction No. 60, of December 20, 2018	Enterobacteriacea; *Salmonella* spp. Enterobacteriacea; *Salmonella* spp. *Escherichia coli* STEC (serogroups O157, O26, O45, O103, O111, O121 e O145)	Pork carcasses Cattle carcasses Beef trimmings	Brasil (2018a); Brasileiro (2020)
6. Ordinance No. 1023, of February 29, 2024	Enterobacteriaceae	Poultry carcasses	Brasil (2024a)

Captions:
1. Ordinance SDA/MAPA No. 1,266, of April 16, 2025 - Establishes measures for monitoring and controlling chemical residues and contaminants in the production chains of food of animal origin, applied within the scope of the National Program for the Control of Residues and Contaminants in products of animal origin;
2. Normative Instruction No. 9, of April 8, 2009 - Establishes procedures for the control of Listeria monocytogenes in products of animal origin;
3. Internal Standard No. 4, of December 16, 2013 - Approves the Program for evaluation of physicochemical and microbiological conformity in products of animal origin and supply water from slaughterhouses registered with the Federal Inspection Service (SIF) and imported edible products of animal origin;
4. Normative Instruction No. 20, of October 21, 2016 - Establishes the Control and Monitoring of Salmonella spp. in commercial poultry slaughterhouses producing broiler chickens and turkeys and in slaughterhouses of broiler chickens, chickens, broiler turkeys and breeding stock, registered with the Federal Inspection Service (SIF);
5. Normative Instruction No. 60, of December 20, 2018 - Establishes the microbiological control of pork carcasses and beef carcasses in slaughterhouses registered with the Animal Products Inspection Department;
6. Ordinance No. 1023, of February 29, 2024 - Approves the procedures for the microbiological evaluation of the hygienic-sanitary performance of the broiler slaughtering process in slaughterhouses registered with the Federal Inspection Service – SIF.

The evaluation of physicochemical and microbiological conformity in products of animal origin is another strategy for monitoring and controlling food safety adopted in Brazil since 2013, through the implementation of the Program for Evaluation of Physicochemical and Microbiological Compliance in Products of Animal Origin (PACPOA), including the collection of samples of products of animal origin made in industries/slaughterhouses registered with the SIF or in imported products (MAPA 2013; MAPA 2024a).

The establishment in Brazil of the Program for Evaluation of Physicochemical and Microbiological Compliance in Products of Animal Origin (PACPOA)

Therefore, since 2013, the SIF carries out the Program for Evaluation of Physicochemical and Microbiological Compliance in Products of Animal Origin (PACPOA), which was officially instituted by means of the Secretariat for Animal Defense (SDA) through Internal Standard No. 4 of December 16, 2013 (MAPA 2013). The aims of this program include obtaining laboratory results to determine the Conformity Index of Products of Animal Origin and to support the evaluation of product and process self-controls carried out by industries/slaughterhouses; and the systematization of data for risk assessment, planning and management of risk-based inspection actions, with a focus on the safety and identity of products of animal origin, as well as combating fraud.

Decree 9.013, of March 29, 2017 (Brasil 2017) and its amendments, are currently the legal basis for the application of the PACPOA program as a way of official verification of product and process conformity, since it gives the SIF the prerogative, whenever it deems it necessary, to collect samples for physical, microbiological, physicochemical, molecular biology, histological and other laboratory analyses that may be necessary to assess conformity, using standardized and validated and/or internationally recognized methodologies (Brasil 2017).

Managing and carrying out the collection and analysis of PACPOA animal product samples among more than 3,000 industries/slaughterhouses registered with SIF and the six LFDAs, in a country of continental dimensions, is a major challenge for the Ministry of Agriculture and Livestock. The Ministry has invested in standardizing procedures and drawing up manuals for collecting and sending samples, procedures and criteria for receiving samples in laboratories, validating official laboratory methods, specific training for SIF staff, as well as investing in projects to digitally transform official programs, from recording sample collection to receiving laboratory results (Brasil 2018b; Brasil 2021; MAPA 2024a; SDA 2024).

When laboratory analysis results from official programs, including PACPOA, are found not to comply with SIF legislation, appropriate fiscal actions are taken, such as issuing a notice of infraction to the industries/slaughterhouses and investigating the irregularities, imposing fines, seizing the product, provisionally suspending the manufacturing process, ordering a review of self-control programs and recalling products, as appropriate, in order to safeguard consumer health (Brasil 2017; MAPA 2024a).

The Ministry of Agriculture and Livestock has published the results of official programs on its website every year since 2014, including the PACPOA. The results of this program in 2024 indicate that 24,786 physicochemical and microbiological analyses were carried out on 6,478 samples of animal products collected in industries/slaughterhouses registered with the SIF. Of these samples, the percentage of compliant samples observed was 84.21% (5,455/6,478). Among the samples analyzed for microbiological parameters, the percentage of compliance was 87.85% (2,863/3,259), with 81.71% (1,233/1,509) for milk and milk products, 81.82% (63/77) for eggs and egg products, 93.22% (1,375/1,475) for meat and meat products, and 96.97% (192/198) for fish and fishery products. Among the samples analyzed for physicochemical parameters, there was a compliance percentage of 80.52% (2,592/3,219), of which 73.85% (113/153) for honey and bee products, 80.91% (2,658/3,285) for milk and milk products, 80.95% (136/168) for eggs and egg products, 87.76% (2,073/2,362) for meat and meat products, and 93.14% (475/510) for fish and fish products (MAPA 2025).

These findings are consistent with Lueckl et al. (2019) in Austria, in Austria's official food monitoring program. According to these authors, the results indicate a percentage of non-compliance of 16.4% (compliance of 83.6%), in a total sample of 209,209 samples collected between 2010 and 2016, with 0.44% (917 samples) being considered samples that present a direct risk to public health, mainly because they contain pathogens. Similarly, Fontcuberta-Famadas et al. (2015) found 15.5% of non-compliant samples in the last few years (2008–2012) of the Food Health Quality Investigation Program in Barcelona, of which microbiological parameters accounted for 72% of cases (mainly related to hygiene indicator microorganisms) and additives (16%).

Considering the health quality requirements related to meeting the global market for the commercialisation of animal products in Brazil, the quality maintenance concerns related to the inspection of animal products conducted by Brazil are also analogous to other programs conducted internationally. Other countries have different ways of monitoring and evaluating the safety and quality of products.

In Barcelona, Spain, since 1984, there has been a Food Sanitary Quality Investigation Program, as a tool for monitoring additives, chemical or microbiological contaminants in food sold in the city (Fontcuberta-Famadas et al. 2015). In Austria, a risk-based national food control plan is drawn up every year, involving the definition of an annual sampling plan with the number of samples per food category,

and an annual plan of inspections in food-producing establishments. In addition to planned samples, samples can also be taken if there is suspicion of contamination, because of consumer complaints or reports, and to investigate notifications from the RASFF (Rapid Alert System for Food and Feed) system (Lueckl et al. 2019). In China the national "Food Safety Law" of 2009 determined that food samples should be tested both systematically and randomly by official authorities (Jia and Jukes 2013). In Indonesia, Barinda and Ayuningtyas (2022) proposed a conceptual framework for the food control system, with the construction of indicators adapted to the reality of Indonesia, including as one of the result indicators the calculation of the percentage of food products that meet safety and quality requirements.

The results of the PACPOA program can contribute to food safety governance strategies and mechanisms in Brazil, guiding public policies, prioritizing product risks, combating fraud, and ensuring consumer safety and rights. This strategy is aligned with the global food safety awareness campaign led by the World Health Organization (WHO), as well as with actions for the surveillance and prevention of foodborne diseases, the economy, and sustainable development.

As a future prospect and opportunity for improvement of the PACPOA program, as observed by Fontcuberta-Famadas et al. (2015) in Spain, advances in the computerization of sample collection and processing of laboratory results of the PACPOA program may provide improvements in the descriptive and statistical evaluation of results, as well as transparency of information.

Due to its objectives and solid legal basis, the PACPOA Program currently represents one of the most important monitoring and control tools carried out by SIF in relation to industries and slaughterhouses, with the aim of ensuring the safety and innocuousness of food of animal origin.

Conclusion

In Brazil, the Federal Inspection Service (SIF) acts to protect consumer health by developing programs based on legislation and applying product compliance standards related to the safety and quality of animal products, monitored in the PACPOA program. The PACPOA is aligned with Brazilian legislation and international guidelines, with the monitoring of products of animal origin in industries/slaughterhouses, using official laboratories and internationally validated and/or recognized analytical methods, providing transparency on the safety, identity and quality of products in industries registered with the SIF, and is aligned with product monitoring strategies in other countries. The results in 2024 indicate that the percentage of compliant samples observed was 84.21% (5,455/6,478), with 87.85% (2,863/3,259) for microbiological parameters and 80.52% (2,592/3,219) for physicochemical parameters, and are compatible with compliance results in other countries.

Author contributions

AAO and CBM conceived and prepared the draft manuscript; AAO, CVGCS, CSR, CSMR, CM, JBF, and CBM, critically revised the manuscript. All the authors approved the final version.

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